STUDENT'S HAND-BOOK

OF

MUSHROOMS OF AMERICA

EDIBLE AND POISONOUS.

BY

THOMAS TAYLOR, M. D.

AUTHOR OF FOOD PRODUCTS, ETC.

Fellow of the A. A. A. S.; Hon. Member of the Mic. Section Royal Inst., Liverpool, England; Member of Honor of the International Medical Society of Hygiene, Brussels; Member of the American and Washington Chemical Societies; French Chemical Society, Paris; of the American Textile Society; Medical Society of Washington, D. C.; Cor. Member Academy of Arts and Sciences of Brooklyn, N. Y.; Cor. Member Mic. Societies of New York, Buffalo, etc., etc.

Published in Serial Form—No. 5—Price, 50c. per number.

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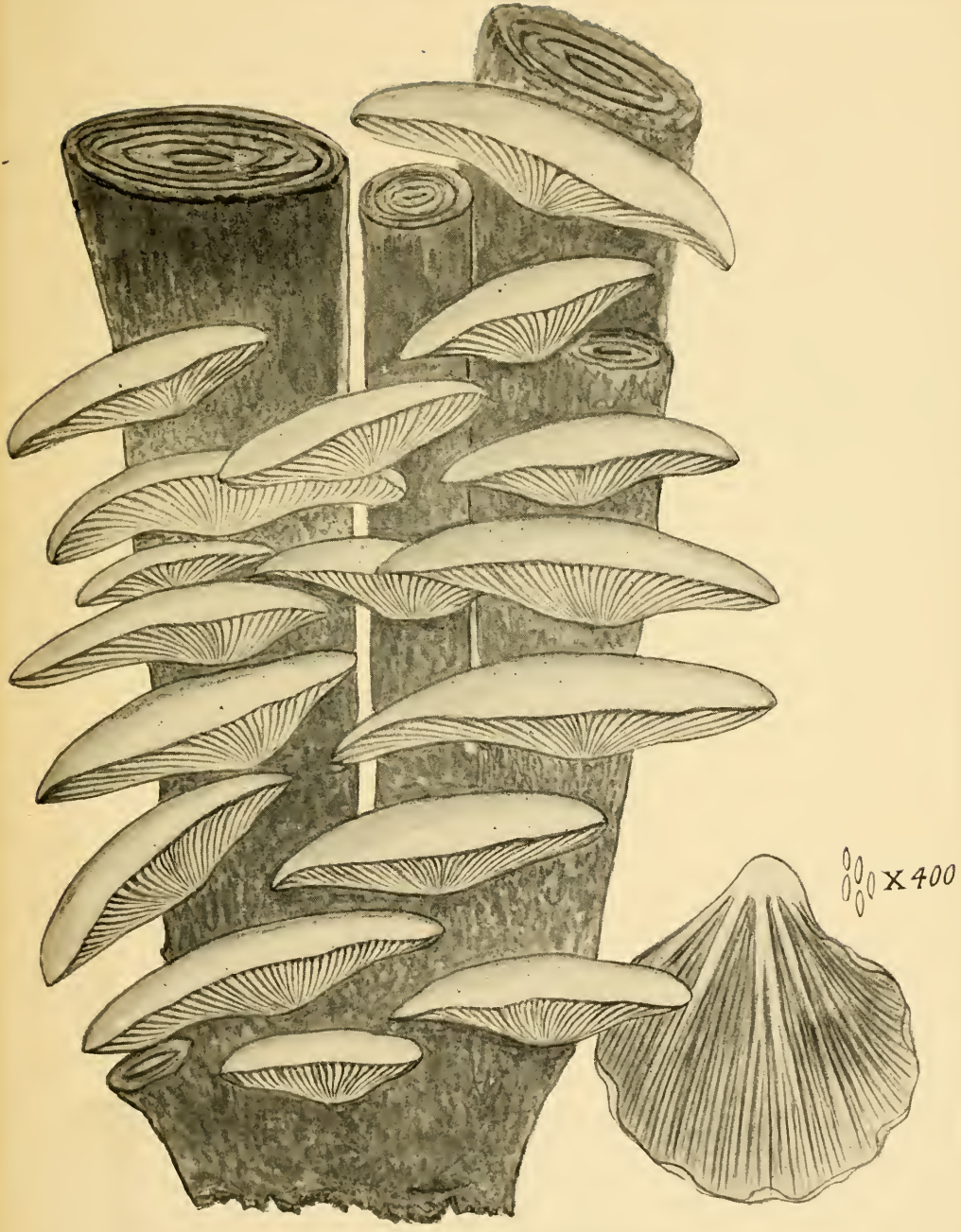
PUBLISHER'S NOTE.

It has not been possible to represent all the genera of mushrooms which contain species having value as esculents within the compass of this series of five pamphlets, but the demand for these promises to justify the publication, at a future date, of a second series, which the author now has in preparation.

A. R. T.



T. Taylor, del.

Agaricus (Pleurotus) ostreatus, Jacq.
Edible.

AGARICINI.

Leucospori—(Spores White).

Subgenus *Pleurotus* Fries. The Pleuroti are similar in some respects to the Tricholomas and Clitocybes, some of the species having notched gills near the stem, and others, again, having the gills decurrent, or running down the stem. Most of the species grow upon dead wood or from decaying portions of live trees. Very few grow upon the ground. The stem is mostly eccentric, lateral, or wanting; when present it is homogeneous or confluent with the substance of the cap: the substance may be compact, spongy, slightly fleshy, or membranaceous. Veil evanescent or absent. The spores are white or slightly tinted.

M. C. Cooke figures over thirty species of Pleurotus found in Great Britain, and describes 45 species found in Australia. With few exceptions, all of these grow upon wood. Very few have value as esculents.

Plate A.

Ag. (Pleurotus) ostreatus Jacq. "*Oyster Mushroom.*"

Edible.

Cap soft, fleshy, smooth, shell-shaped, white or cinereous, turning brownish or yellowish with age. Flesh white, somewhat fibrous. Gills white, broad and decurrent, anastamosing at the base. Stem usually not well defined, lateral, or absent. Spores elliptical, white. The caps are sometimes thickly clustered and closely overlapping, and sometimes wide apart. This mushroom has long been known as edible both raw and cooked. It has a pleasant but not decided flavor and must be cooked slowly and carefully to be tender and easily digestible. Old specimens are apt to be tough. It is found on decaying wood and often on fallen logs in moist places or upon decaying tree-trunks. It is frequently recurrent on the same tree. I have gathered great quantities of the Oyster mushroom during several seasons past from a fallen birch tree which spanned a small stream. The lower end of the tree rested on the moist ground at the edge of the stream. Specimens have been found on the willow, ash and poplar trees, and upon the apple and the laburnum.

Pleurotos *sapidus* Kalchb. *Sapid Pleurotus.* Edible.

This species closely resembles the Oyster mushroom in form and habit of growth, and is by some considered only a variety of *P. ostreatus.* It grows usually in tufts with the caps closely overlapping, varying in color white, ashy, grayish or brownish. Flesh white. The stems are white, smooth and short, mostly springing from a common base. The gills are white and very broad, and decurrent. The spores assume a very pale lilac tint on exposure to the atmosphere.

Pleurotus *ulmarius* Bull. "*Elm Pleurotus.*" Edible.

The Elm Pleurotus is quite conspicuous by reason of its large size and light color. The cap is smooth and compact, usually whitish with a dull yellowish tinge in the center. Flesh white. The skin cracks very easily, giving it a scaly appearance. The gills are broad, and toothed or notched near their point of attachment to the stem as in the Tricholomas, white in color, turning yellowish with age. The stem is firm and smooth, solid and rather eccentric, thick and sometimes slightly downy near the base, from two to four inches in length. Although this mushroom seems to prefer the elm and is most frequently found on trees of that species, it is found also upon other trees, but principally the maple, the ash, the willow, and the poplar. It grows upon live trees, usually where the branches have been cut away, and upon stumps as well. Most authors recommend it as an esculent, although it has not the rich flavor of some other mushrooms. It dries well and can be kept thus for winter use. This species has a wide range and grows most abundantly in the autumn. Its resistance to cold has been frequently remarked.

AGARICINI.

Subgenus *Amanita.* The Amanitas are usually large and somewhat watery, the flesh brittle rather than tough. The very young plants are enveloped in a membranous wrapper, which breaks apart with the expansion of the plant, leaving a more or less persistent sheath at the base of the stem. The universal veil is distinct and free from the cuticle of the cap. The cap is convex at first, then expanded; in some species naked and smooth; in others, clothed with membranaceous patches of the volva. The stem is distinct from the fleshy substance of the cap, ringed and furnished with a volva or sheath. In some of the species this sheath is connate with the base of the stem, firm and persistent. In others, it is friable, at length nearly obsolete.

The ring is usually persistent, deflexed, more or less prominent, in rare cases pressed close against the stem, and sometimes scarcely distinguishable from it. The gills in most of the species are free from the stems, but there are exceptions to this rule. Spores white. As to geographical distribution, according to M. C. Cooke, seven-eighths of the species are distinctly located in the temperate zone, one-twentieth at a temperate elevation, and only one-twentieth presumably tropical. Out of the eighty species, about sixty are North American and European, and one species is found on the slopes of the Andes, in South America. As heretofore stated, this group among mushrooms is made responsible for most of the well authenticated cases of fatal poisoning by mushrooms. It would be judicious, therefore, for those who are not thoroughly familiar with the characteristics of the edible Amanitas to defer making experiments with them for table use until that familiarity is acquired.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Saccardo in his *Sylloge* describes no less than fifteen edible species of Amanita as found in different parts of the world. Of these I have personally been able to identify but three which are common in this country, and which have been well tested. Specimens of these three species are illustrated in Plates XIV and XIV½ of this pamphlet. They are each and all found in varying abundance in different parts of the United States.

Plate XIV.

Figs. 1 to 4.—Ag. (Amanita) Cæsareus Scop. (Amanita Cæsarea). "*Orange Amanita*," "*True Orange*."

Edible.

Cap at first convex, afterwards well expanded; *smooth*, free from warts, striate on the margin; color orange-red or bright lemon-yellow, with red disk; gills lemon-yellow, rounded near the stem, and free from it; stem equal or slightly tapering upwards, stuffed with cottony fibrils, or hollow (color clear lemon-yellow), bearing a yellowish ring near the top and sheathed at the base with large, loose, membranous, white volva. Odor faint but agreeable. Spores white, elliptical.

The whole plant is symmetrical in form, brilliant in coloring, clean and attractive in appearance. The American plant seems to differ in some slight respects from the European as figured and described in European works. In Europe the pileus or cap is said to vary in color, being sometimes white, pale yellow, red or even copper color, although it is usually orange-yellow. My own observation of the American plant of this species agrees with that of Prof. Peck in that the cap is uniform in color, being at first bright reddish-orange or even brilliant red, fading with age to yellow, either wholly or only on the margin. No white specimens have been as yet recorded in this country. The red color disappears in the dried specimens. The striations of the margin are usually quite deep and long and almost as distant as in the edible species Amanitopsis *vaginata*. Some European writers have described the flesh or substance of the cap as yellowish. In our plant the flesh is white, but stained with yellow or red immediately under the cuticle. Amanita *Cæsarea* is the only one of the Amanitas which has yellow gills.

Berkeley, in his "Outlines of British Fungi," describes A. Cæsarea as it is found in some parts of Continental Europe, but states that up to the date of his writing it had not been found in Great Britain. It is not recorded in the more recent lists of British fungi by M. C. Cooke nor in that of Australian fungi by the same author. The species has a wide range in this country, and though not very common in the North, in some localities, as in the pine and oak woods of North Carolina, it is found in great abundance. Dufour states that it is much esteemed as an esculent in France, and though rare in the northern part of that country, it is

common in the center and the south of France in autumn. It is well known in different portions of Continental Europe, and is frequently figured in contrast with its very poisonous congener, Amanita muscaria, or "False Orange," commonly known as the "Fly Amanita," or "Fly-Killer."

A careless observer might mistake one for the other, but with a little attention to well-defined details the edible form can be readily distinguished from the poisonous one.

In analyzing the species the attention should be directed to the following characteristics of the two mushrooms: In A. *Cæsarea* the cap is *smooth*, the stem, gills and ring *lemon-yellow*, and the cup-shaped wrapper or volva which sheathes the base of the stem is white and *persistently membranous*.

In A. *muscaria* the cap is *warty* or shows the traces or remains of warts; the gills *white*, stem *white*, or only very slightly yellowish, and the wrapper or volva is evanescent, breaking up into ridge-like patches adhering to the base of the stem.

The Amanita Cæsarea has long been esteemed as an esculent in foreign countries, and was known in ancient times to the Greeks and Romans. It is known under the following names: "Orange," "Cæsar's mushroom," "Imperial mushroom," "Yellow-egg," "Kaiserling," etc. Mycologists who have tested it agree as to its edibility and delicate flavor.

The specimens figured in Plate XIV represent the average size of those which I have gathered in the vicinity of the District of Columbia. Much larger ones have been gathered in the woody portions of Druid Hill Park, Baltimore, Md.

Dufour writes: "This mushroom, the "true oronge," is cooked in a variety of ways, and it always constitutes an exquisite dish. This author gives the following recipes for cooking the *Cæsarea*, which he calls the "Oronge:"

Oronge à la bordelaise.—The stem is minced with fine herbs, bread-crumbs, and garlic, and seasoned with pepper and salt. This hash is placed in the concavity of the caps, and all is put to bake with good oil in a pan steamed in a chafing dish.

Oronge à l'Italienne.—Stew gently with a little butter and salt, then serve with a sauce composed of oil seasoned with the juice of lemon, pepper, garlic, and extract of sweet almond.

The Spanish are fond of this mushroom, and it is said to enter into their national dish, olla podrida, a mixture of meat, vegetables, and spices, whenever it can be obtained.

It is sometimes fried in butter or olive oil and seasoned with sugar.

T. Taylor, del.

Agaricus (Amanita) strobiliformis, Vitt. "Fir-Cone Mushroom."
Edible.
From Nature.

Plate XIV.

Figs. 5 to 9.—Ag. (Amanita) rubescens Pers. (Amanita rubescens). "*The Blusher*," "*Reddish Brown Amanita.*"

Edible.

Cap at first convex then expanded, margin even or very slightly striated, usually reddish-brown or reddish-fawn color, covered with mealy, more or less persistent warts; flesh white, changing to a reddish or pinkish tinge, where cut or bruised, the reddish tinge most intense in the bulbous portion of the base of the stem; *gills reaching the stem and forming decurrent lines upon it*, white, becoming spotted with rusty or wine red stains when bruised or attacked by insects; stem ringed, whitish or dingy white, becoming brownish or spotted, with reddish-brown stains. The base of the stem is usually bulbous, the bulb sometimes tapering to a point at the root, and in some instances ending abruptly.

The ring or collar which encircles the stem near the top is membranous, and usually well defined.

The volva which completely envelops the young plant is very friable and soon disappears. Fragments of the volva may be seen in the shape of scales or small particles upon the mushroom stem, and in wart-like patches upon the cap. In the representations of this mushroom which appear in European works the cap is a deeper reddish-brown tint than I have found it here. The color of the cap is usually a light reddish brown or reddish gray, sometimes almost white. This species is found usually in light open woods. In a warm moist climate it appears early in the season, and can be gathered until the frosts come. Taste very pleasant.

There is a poisonous species, Amanita *pantherinus*, rare, which has a viscid brown warted cap bearing a slight resemblance to that of the *rubescens*, but the gills do not turn red when bruised, and the volva at the base of the stem is well defined and persistent.

The *rubescens* is very plentiful in the woods of Maryland and Virginia, and specimens have been received from different parts of the country. I have frequently eaten it stewed with butter, and found it very good eating. Hay speaks of it as being eaten in England, where it is called the "Blusher." Cooke says it is pleasant both in taste and odor. It is spoken of by French authors as of delicate flavor, and as well known in some parts of France. In preparing for the table bring the mushroom to a quick boil and pour off the first water, then stew with flavoring to suit the taste.

The specimens of this species represented in Plate XIV were collected in the woods of Forest Glen, Maryland. They are often found of much larger size and much lighter in coloring, with the stains upon the gills redder in color. The very young plants as they burst through the sur-

face of the soil show a distinct volva at the base of the stem. In the mature plant this disappears, often leaving the slightly bulbous base quite smooth.

PLATE XIV½.

Ag. (Amanita) strobiliformis Fries (Amanita strobiliformis). "*Fir-cone Mushroom.*"

EDIBLE.

Cap fleshy, convex at first, then expanded, covered with persistent white warts, margin even, white; flesh white, firm and compact; gills rounded behind and free from the stem, white; stem solid, the bulbous base tapering, furrowed with concentric and longitudinal channels at the root, and extending well into the ground, white; ring large, soon splitting; volva breaking up and appearing in concentric ridges upon the stem. Spores white.

This mushroom is very pleasant to the taste when raw as well as when cooked. It is found in light woods or on the borders of woods where the soil is somewhat friable, generally solitary, but sometimes two or three are found clustered together. The plants are sometimes so large that two or three of them would make a very good meal. Specimens have been found with the cap measuring 8 to 9 inches across when expanded, the stem varying from 6 to 8 inches in height, and from 1 to 3 inches in thickness. When young the plants are generally snowy white throughout, changing with age to a dingy white or cinereous hue. The specimens figured in the plate formed one of a cluster of three mushrooms of this species found growing in the fir woods of the District of Columbia.

During some seasons I have found the *strobiliformis*, or "Fir-cone mushroom," fairly plentiful in some parts of Maryland, and in other seasons it has been rare. The whole plant when young is enclosed in a white membranous wrapper.

Although this species is very generally recognized by mycologists as edible, I would advise great caution in selecting specimens for table use, since there is a dangerous species which might be mistaken for it by one not familiar with the characteristics of both species; I refer to a form of Amanita muscaria with ochraceous yellow cap which, when faded or bleached by the sun and rain, sometimes approaches, in tint, the dingy white of old or faded specimens of the *strobiliformis*. Both species have *white gills*, *white stems*, and *white flocculent veil*. The volva is evanescent in both, leaving traces of its existence in concentric ridges at the base, and part way up the stem.

In the species *strobiliformis*, the flesh of the cap is white throughout, as well as the cuticle.

In the yellowish *muscaria*, the flesh *immediately* beneath the cuticle of the upper surface of the cap is yellowish, frequently deepening at the disk to orange hue.

T. Taylor, lith.

Figs. 1 to 7. Ag. (Amanita) muscarius, Linn. (Amanita muscaria) "Fly Mushroom."

Fig. 8. Ag. (Amanita) phalloides, Fries.

Fig. 9. Ag. (Amanita) mappa Batsch.

The cap of Amanita *muscaria* is very attractive to flies, but proves to them, as also to roaches and to some other insects, a deadly poison.

The juice of *strobiliformis* is not poisonous to flies. This fact may aid in identifying the species.

Subgenus *Amanitopsis Roze.* The species of this subgenus were formerly included in Amanita. The characteristic which separates it from Amanita is the *absence of a ring on the stem.* The gills are free from the stem, the spores are white, and the whole plant in youth is encased in an egg-shaped volva.*

Amanitopsis *vaginata Roze.* Edible.

This species is very common in pine and oak forests. The plant, as a whole, has a graceful aspect and grows singly or scattered through open places in the woods. It is somewhat fragile and easily broken. The cap in this species is usually a mouse-gray, sometimes slaty gray or brownish, generally umbonate in the center and distinctly striated on the margin.

The stem is white, equal, and slender in proportion to the width of the cap, and sheathed quite far up with a loose white membranous wrapper. This sheath is so slightly attached to the base of the stem that it is often left in the ground if the plant is carelessly pulled. The gills are white, or whitish, free from the stem and rounded at the outer extremity.

There is a white variety, (variety *alba*) A. *nivalis*, in which the whole plant is white, and a tawny variety (A. *fulva* Schaeff.) in which the cap is a pale ochraceous yellow, with the gills and stem white or whitish. In the variety A. *livida* or A. *spadicea* Grev. the cap is brown, while the stem and gills are tinged a smoky brown.

These are all edible and of fairly good flavor. Except in the absence of the ring upon the stem, the light varieties might be mistaken for small forms of the poisonous species Amanita *verna* or of *phalloides*. Great caution should therefore be observed, in gathering for the table, to be sure of the species.

Plate XV.

Figs. 1 to 7.—Ag. (Amanita) muscarius Linn. (Amanita muscaria). "*Fly Mushroom*," "*False Orange.*"

Poisonous.

Cap warty, margin striate; gills white, reaching the stem, and often forming decurrent lines upon it; stem white, stuffed, annulate, bulbous at the base, concentrically ridged or scaly at the base, and sometimes part way up, with fragments of the ruptured wrapper. Spores widely elliptical, white, .0003 to .0004 of an inch in length.

* Although this subgenus is not included in M. C. Cooke's analytical key to the order of Agaricini, published with his kind permission in No. 3 of this series, he now includes it as one of the subgenera which should have a place in that list.

The plants of this species vary very much in size and in the color of the cap. The latter is sometimes a bright scarlet and again it is orange color, more frequently ochraceous yellow, fading to a very pale yellow tint. In the variety *albus* it is white. The stem is stuffed with webby fibrils and varies very much in thickness: sometimes in young specimens it is very stout, with a thick ovate bulb reaching well up towards the cap, and again it is comparatively slender and nearly equal from the cap down to a very slight bulb at the base. The very young plant is completely enveloped in a white or yellowish egg-shaped wrapper or volva, which, being friable, generally breaks up into scales, forming warts upon the upper surface of the cap. When the plant is young and moist the cap is slightly sticky. A thickish white veil extends from the stem to the inner margin of the cap. This breaks away with the growth and expansion of the plant and falls in lax folds, forming a deflexed ring round the upper portion of the stem.

This mushroom is very common in woods and forests in summer and autumn, and has a wide geographical range. It is recorded by all mycologists as poisonous. One author states that when eaten in very small quantities it acts as a cathartic, but that it causes death when eaten freely. Flies find in it a deadly poison, and the poisonous alkaloids are not destroyed by drying.

Although cases are cited where this mushroom has been eaten without injury, its fatally poisonous effects have been too well and too often tested to allow of any doubt as to the danger of eating it, even in small quantities.

Amanita Frostiana, Frost's Amanita, is a much smaller species than A. muscaria. It bears a very close resemblance to the Fly Amanita, and might easily be taken for a small form of the same. The cap is yellowish and warted, and specimens occur in which the stem and gills are slightly tinged with yellow. It is poisonous.

Plate XV.

Fig. 8.—Ag. (Amanita) phalloides Fries (Amanita phalloides) A. vernalis Bolt., A. verrucosus Curtis. "*Poisonous Amanita*," "*Death Cup.*"

Poisonous.

Cap bell-shaped or ovate at first, then expanded, smooth, obtuse, viscid, margin even, creamy-white, brown, or greenish, without warts: flesh white; stem white, hollow or stuffed, bulbous at the base, annulate; gills rounded and ventricose, coarse, and persistently white, free from the stem; volva conspicuous, large, loose, adhering to the base, but free from the stem at the top, with the margin irregularly notched. In the white forms there is frequently a greenish or yellow tinge at the disk or centre of the cap. The white form is most common, but the brownish is often found in this country. I have not yet found the green-capped variety some-

T. Taylor del.

Fig. 1. Ag. (Amanita) vernus, Bull. (Amanita verna.) "Spring Mushroom."
Fig. 2 Represents section of mature plant.
Fig 3. Spores; Fig. 4. Young plant.

POISONOUS.

times figured in European works. In the brown variety the stem and ring are often tinged with brown, as also the volva. The cap is usually from 2 to 3 inches broad, and the stem from 3 to 5 inches long. The whole plant is symmetrical in shape and clean looking, though somewhat clammy to the touch when moist. It is very common in mixed woods, in some localities, and is universally considered as fatally poisonous.

The white form of A. *phalloides*, although in reality bearing very little resemblance to the common field mushroom, has been mistaken for it as also for the *Smooth white lepiota*, and in some instances has been eaten with fatal results by those who gathered it.

The distinction between this most poisonous Amanita and the common field mushroom is well marked. In the common mushroom the *gills* are *pink, becoming dark brown*, the *spores purplish brown*, and the whole mushroom is stout and short stemmed, the stem being shorter than the diameter of the cap, and having no volva, or wrapper at its base. In the species A. *phalloides* the *gills* are *persistently white* and the bulb is distinct and broad at the base, the white cup-shaped wrapper sheathing the base of the stem like the calyx of a flower. The *Smooth white lepiota* shows neither volva nor trace of one, and has other distinct characteristics which distinguish it from A. *phalloides*. See page 14, No. 4 of this series.

The specimen figured in Plate XV grew in Maryland, where it is quite common.

Plate XV.

Fig. 9.—Ag. (Amanita) mappa (Amanita mappa) Linn., Amanita citrina, A. virosa.

Poisonous.

Cap at first convex, then expanded, dry, without a separable cuticle, not warty but showing white, yellowish, or brownish scales or patches on its upper surface; gills white, adnexed; flesh white, sometimes slightly yellowish under the skin; stem stuffed, then hollow, cylindrical, yellowish white, nearly smooth, with a distinctly bulbous base; volva white or brownish. Odor pleasant. Spores spheroidal. The cap in this species is somewhat variable in color, but those having a white cap are most common. The plant is not so tall as those of the species *phalloides*. It is solitary in habit, and is found usually in open woods.

Curtis and Lowerby figure *mappa* and *phalloides* under the same name.

Plate XVI.

Figs. 1 to 4.—Ag. (Amanita) vernus Bull. (Amanita verna) Linn., Amanita bulbosa, Ag. solitarius. "*Vernal Mushroom*," "*Spring Mushroom*," *etc.*

Poisonous.

Cap at first ovate, then expanded, becoming at length slightly depressed, viscid, white; margin smooth; flesh white; gills white, free: stem white,

equal, stuffed or hollow, easily splitting, floccose, with bulbous base; volva white, closely embracing the stem, but free from it at the margin; ring reflexed; spores globose, .0003 in. broad. The plant is creamy white throughout and does not seem to be easily distinguishable from the white forms of A. *phalloides*. Fries and some others consider this species merely a variety of Amanita *phalloides*, and it is regarded as equally poisonous, the poisonous principle being the same as that of A. *phalloides*. It is very common in mixed woods from early spring to frosty weather.

ALKALOIDS OF THE POISONOUS MUSHROOMS.

Schrader, after some experiments made in 1811, stated that the poisonous principle of the "Fly mushroom," Amanita muscaria, seemed to be combined with its red coloring matter and might be extracted by water or aqueous alcohol, but that it was not soluble in ether.

Vaquelin, as the result of more extended investigations made in 1813, expressed the opinion that this poison was not confined to the coloring matter of the mushroom, but that it was an integral part of the fatty constituents not only of *muscaria* but of several species of mushrooms. In 1826 and 1830, and again in 1867, important investigations were made and published by Letellier relating to the medical and poisonous properties of mushrooms growing around Paris. Letellier's early investigations led him to the conclusion that there were two poisons contained in certain fungi—(1) an acrid principle easily destroyed by drying or boiling or by maceration in alcohol or in alkaline solution, and (2) a peculiar poisonous alkaloid found only in certain of the Amanita group. Letellier in 1866 named this latter alkaloid *amanitin*. He then considered it to be the active poison of Amanita *muscaria*, Amanita *phalloides*, and Amanita *verna*, but a subsequent analysis by the German chemists Schmiedeberg and Koppe showed the *amanitin* of Letellier to be identical with *cholin*, a substance found in bile. Kobert says that *amanitin* is non-poisonous in itself, but states that it may be changed on decay of the mushroom to the muscarin-like acting *neurin*, which is highly poisonous. He thinks it highly probable that nearly all of the edible and non-edible mushrooms contain pure *amanitin* (cholin) partly in primitive condition and partly in a more intricate organic connection, as *lecithin*. It has been demonstrated that amanitin separates very readily from lecithin during the *decay or careless drying* of mushrooms and changes into the *poisonous neurin*; hence the necessity of using mushrooms only when *perfectly fresh* or when *quickly dried*.

Muscarin.

To the eminent German chemists Schmiedeberg and Koppe is due the credit of isolating the active poisonous principle of the Fly mush-

* The earliest account of the separation of the poisonous principles of the mushrooms of the genus Amanita dates back to the experiments of Apoiger in 1851. Harnack's researches were published in 1876 and those of Huseman in 1882.

room (*muscarin*). These authors published in 1869 a series of interesting experiments made with *muscarin*, having relation to its effect upon the heart, respiration, secretions and digestive organs, etc., and this was supplemented by other experiments made by their pupils, Prof. R. Boehm and E. Harnack. Schmiedeberg and Koppe's work relates to the effect of this poison on man as well as upon the lower animals. Dr. J. L. Prevost in 1874 reviewed the investigations made by Schmiedeberg and Koppe in a paper read before the Biological Society of Geneva, adding some confirmatory observations of his own relative to experiments made with muscarin upon the lower animals. The experiments made by these authors demonstrated "that muscarin arrests the action of a frog's heart, that a muscarined frog's heart began to beat immediately under the influence of atropin, and further that it was impossible to muscarine a frog's heart while under the influence of atropin."

Schmiedeberg subjected cats and dogs to doses of muscarin, large enough to produce death, and when the animals were about to succumb, injected hypodermically from one to two milligrams of sulphate of *atropin*, after which the toxic symptoms disappeared and the animals completely revived. Prof. Boehm found that *digitalin* likewise re-established heart action when suspended by the action of muscarin.

In man the fatal termination, in cases of mushroom poisoning, where the antidote is not used, may take place in from 5 to 12 hours or not for two or three days.

According to Prof. R. Kobert's recent chemical analysis, the "Fly mushroom," Amanita muscaria, contains not only the very poisonous alkaloid *muscarin* and the *amanitin* of Letellier (*cholin*), but also a third alkaloid, *pilz-atropin*. The pilz-atropin (mushroom atropin) was discovered by Schmiedeberg in a *commercial* preparation of *muscarin*, and later Prof. Kobert discovered it in varying proportions in fresh mushrooms of different species. The effect of this third alkaloid, it is claimed, is to neutralize to a greater or less extent the effect of the poisonous one. Under its influence, when present in quantity, the poison is almost entirely neutralized. Contraction of the pupils changes to dilation, and slowing of the pulse may disappear. Only through the presence of this natural antidote in the Fly mushroom, says Kobert, is it possible, as in some parts of France and Russia, to eat without danger this mushroom, which contains 10% of sugar (trehalose or mycose) in a fermented and unfermented condition. He states also that delirium, intoxication, and other symptoms which, according to Prof. Dittmer of Kamschatka and various scientific travellers, are reported effects of the Fly mushroom in the extreme north, are not experienced in the same degree in southern Russia. This difference in action, he thinks, may be very properly attributed to the varying proportion of the above-mentioned atropin in the mushroom or to the presence of substances which develop only in the extreme north.

The symptoms of *muscarin* poisoning, apart from vomiting and purging, are slowing of the pulse, cerebral disturbance, contraction of the

pupils, salivation and sweating. In case of death, which is caused by suffocation or a suspension of heart action, the lungs are found to be filled with air, and there is a transfusion of blood in the alimentary canal.

Prof. R. Kobert, in a lecture delivered before the University of Dorpat in 1891, states that *muscarin* is found equally in the Fly mushroom (A. muscaria), the Panther mushroom (A. pantherinus), Boletus luridus, and in varying quantities in Russula emetica. He states also that though highly poisonous to vertebrates, *muscarin* is not so to flies, and that the noxious principle in A. muscaria which kills the flies is not as yet determined.

It has been shown that the lower animals, such as sheep and geese, as well as man, have been severely poisoned by feeding on the "Fly mushroom," and that in the case of the horse, experiments have demonstrated that even 0.04 of a gramme, 0.62 of a grain, have caused marked symptoms of poisoning.

For *muscarin* as for *neurin* poisoning the antidote is atropin administered internally or by subcutaneous injection.

Phallin.

The toxic alkaloid of Amanita *phalloides* Fries (Amanita *bulbosa*) was examined by Boudier, who named it "*bulbosin*," and by Oré, who named it "*phalloidin*," but their examinations, it is claimed, proved little beyond the fact that it seemed to be in the nature of an alkaloid, identical neither with *muscarin* nor *helvellic* acid.

Oré affirmed that the *phalloidin* of the Amanita phalloides was very nearly related to, and perhaps identical with, strychnine. From this view Kobert and others dissent.

The poisonous principle of Amanita *phalloides* has recently been subjected to very careful analysis by Prof. Kobert. As a result of a large number of experiments and post-mortem examinations held on persons poisoned by A. *phalloides*, Kobert states that the symptoms can be explained uniformly by the action of a poison, to which he gives the provisional name of "*phallin*." This is an albuminous substance which dissolves the corpuscles of the blood, resembling in this and other respects in a remarkable degree the action of *helvellic* acid.

According to Kobert *phallin* has so far only been found in Amanita *phalloides* and in its varieties *verna*, *mappa*, etc. He finds also in this mushroom muscarin and an atropin-like alkaloid.

The symptoms of the phalloides poisoning are complex. Vomiting is accompanied by diarrhœa, cold sweats, fainting at times, convulsions, ending in coma. There is also fever and a quickening of the pulse. All these symptoms, which follow in succession, according to one author, are dependent on two different poisonous substances. The first may be an acrid and fixed poison, for it is found after repeated dryings, as well in the aqueous as in the alcoholic extract. The second acts by absorption, and is purely narcotic.

Phallin has some of the properties of the toxalbumin of poisonous spiders, and is a vegetable toxalbumin.

It has been remarked that in cases of poisoning by A. *phalloides*, the mushroom has tasted very good, and those poisoned felt well for several hours after eating.

Phalloides poisoning is said to bear a marked resemblance to phosphorus poisoning and to acute jaundice. There is no known antidote to the poisonous alkaloid *phallin*.

According to Prof. Kobert's analyses, the proportion of phallin in the dried mushroom amounts to less than 1%, but its effect on account of its concentration is the more intensive.

Extensive experiments made by Kobert with ox blood in regard to the comparative action of different substances in their power of dissolving the red blood corpuscles demonstrate that *phallin* in this respect exceeds all known substances. Kobert states that "If *phallin* be added to a mixture of blood with a 1% solution of common salt, using the blood of man, cattle, dogs, or pigeons, the blood corpuscles will be entirely dissolved by the poison diluted to 1–125,000."

Prof. Kobert states that he has examined the species Boletus edulis, Agaricus campester, and Amanita Cæsarea a number of times, but could never detect the action of phallin in them. Neither has he found it in A. muscaria.

The Poisonous Alkaloid of Gyromitra esculenta Fries (Helvella esculenta Pers.).

Helvellic Acid.

Prof. Kobert writes of a number of cases of poisoning in the Baltic provinces of Russia by the mushroom Helvella *esculenta* Persoon, sometimes called the Lorchel. It should be here stated that the *Helvella esculenta* of Persoon is the *Gyromitra esculenta* of Fries. This mushroom is described as edible and placed in the edible lists by Dr. M. C. Cooke, Prof. Peck, and other distinguished mycologists, who have tested it and found it edible when perfectly fresh.

The poisonous principle of this mushroom was isolated and analyzed by Prof. R. Boehm, of Russia, in 1885. It was by him designated as "*helvellic acid*," and found to be soluble in hot water. Profs. Eugene Bostroem and E. Ponfick, after giving some study to the effects of this mushroom poison, agreed in their report concerning it, which is to the effect that the *quickly dried* H. *esculenta* (Gyromitra *esculenta*) is not poisonous, and that the poisonous acid of the fresh ones may be extracted by means of hot water, so that while the decoction is poisonous the mushroom is not at all so, after the liquid is pressed out. Experiments with this mushroom were made by both authors on dogs, which ate them greedily, but without exception the dogs were very sick afterwards. The

symptoms were nausea, vomiting, jaundice, stoppage of the kidneys, and hæmaglobinuria. The symptoms observed in man correspond to those manifested by the lower animals. Dissection showed the dissolution of innumerable blood corpuscles.

Prof. Kobert, commenting on the experiments made by Bostroem and Ponfick, states that he himself had been furnished yearly with fresh specimens of "H. *esculenta*" (G. *esculenta*) specially gathered for him at Dorpat, and after making various experiments with the freshly expressed juice he became convinced that the poisonous principle greatly varies, the juice sometimes operating as very poisonous, and sometimes as only slightly so. He states also that the proportion of poison in the mushroom varies with the weather, location, and age of the mushroom. The inhabitants of Russia do not eat this mushroom, but in Germany it is eaten dried or when perfectly fresh, after cooking, and after the first water in which it is boiled is removed.

Helvellic acid is not found in Morchella *esculenta* (the true Morel), nor is it known to exist in any other species except G. *esculenta*. It has been stated that there is no antidote for helvellic poisoning after the symptoms have appeared.

A specimen of Gyromitra esculenta was forwarded to me from Portland, Maine, by a member of a mycological club of that city, who stated that this mushroom was quite abundant in the early spring in the woods near Portland and that the plants were eaten by the members of the club, *care being taken to use them only when perfectly fresh*. Indigestion and nausea followed the eating of old specimens, but the general opinion was "favorable to the Gyromitra as an addition to the table." (See page 6, part 2, of this series.)

Prof. Chas. H. Peck, of Albany, while placing this mushroom in his edible list as one which he had repeatedly tested, advises that it should be eaten only when perfectly fresh, as nausea and sickness had been known to result from the eating of specimens which had been kept twenty-four hours before cooking.

I forwarded a number of drawings of the American species of G. *esculenta*, together with a dried specimen of the same received from Maine, to Prof. Kobert, who identified both drawings and specimen as the *Gyromitra esculenta* of Fries, synonymous with the *Helvella esculenta* of Persoon. Prof. Kobert also informs me that he finds the fresh G. *esculenta* perfectly harmless when freed of the water of the first boiling. He says: "My wife and I eat it very often, when in fresh condition, and after the first water in which it is boiled is poured off." The active poisonous principle of this mushroom is the *helvellic acid*, which is soluble in hot water. When the mushroom is gathered fresh and *quickly dried* it is then also innoxious. In this respect it differs from the species *A. muscaria*, in which the poisonous alkaloid *muscarin* is not destroyed in the drying, but remains unchanged for years in the dried mushroom.

The fact that there have been seemingly well-authenticated cases of

fatal poisoning in the eating of this mushroom shows that if used at all it should be eaten *only when the conditions essential to safety are most carefully observed*, and as these mushrooms show varying qualities, according to local conditions of soil and climate, etc., amateurs finding it in localities where it has not been heretofore used should proceed tentatively and with much care before venturing to eat it freely.

Poisonous and Deleterious Mushrooms of the Lactar, Russula, and Boletus Groups.

Lactarius *torminosus* Fries contains in its milky juice an acrid resin which causes inflammation of the stomach and of the alimentary canal. When parboiled and the first water removed, it has been eaten without injurious effects. Lactarius *plumbeus* Bull., Lactarius *uvidus* Fries, Lactarius *turpis* Weinn., and Lactarius *pyrogalus* Bull., all acrid mushrooms, according to Kobert, are similarly poisonous.

Of the "Erdschieber" (Lactarius *vellereus*) and the "Pfefferling" (Lactarius piperatus Scop.) Kobert says they are eaten in parts of Russia and in some places in Germany, but that neither is very safe.

There is a species of *Russula* (R. *emetica*) very common in woods, easily recognized by its smooth scarlet top, white gills, and white stem and by its biting acridity, which, though recorded as poisonous by some authors, is considered edible by others. This mushroom, R. *emetica*, has been subjected to chemical analysis by Kobert, who finds in it *muscarin*, *cholin*, and *pilz-atropin* in varying proportions. Kobert states that in Germany it is "*rightly*" considered poisonous, though eaten in Russia, and ascribes the fact that it is not deemed poisonous in the latter country to the manner in which it is there prepared, the poisonous alkaloid being in greater part eliminated by parboiling the mushrooms, and not merely pouring off the water, but carefully squeezing it out of the parboiled fungi.

To the presence in this mushroom of the neutralizing alkaloid "pilz-atropin" in varying proportions may also be attributed in some measure the safety with which it has been eaten under certain conditions. R. fœtens and other acrid Russulas, as well as Lactars, have been known to produce severe gastro-enteritis.

Considering the foregoing, it would seem the part of prudence at least to avoid such of the Lactars and Russulas as have an acrid or peppery taste.

I think it would be a wise precaution to pour off the water of the first boiling in the case of all mushrooms about which there is a particle of doubt, whether *recorded* as poisonous or not.

Lactarius *torminosus* Fries. Cap fleshy, at first convex, then expanded, at length depressed in the center, slightly zoned, margin turned inwards, pale ochraceous yellow, with flesh-colored mottlings; *downy* or *hairy;* gills whitish, changing to pinkish yellow, narrow and close together; stem

equal, stuffed or hollow, pallid or whitish; milk persistently *white and acrid.* In woods and fields. Specimens have been collected in New York, Massachusetts, Maryland, and Virginia. Cap 3 to 5 inches, stem 2½ to 4 inches.

Lactarius *pyrogalus.* Cap fleshy, slightly zoned, *smooth*, even, and moist, depressed in the center, grayish, or cinereous; gills white or yellowish, thin, not crowded; stem short, stout, stuffed, or hollow, sometimes slightly attenuated towards the root, pallid; flesh white or whitish; milk *white* and *extremely acrid*, copious. Borders of woods and meadows. This mushroom is sometimes called the "Fiery Milk Mushroom."

Lactarius *uvidus* Fries. Cap thin, convex, then plane, and slightly depressed in the center, sometimes showing slight umbo, viscid, *zoneless*, smooth, dingy gray or pallid brown, margin turned inwards; gills narrow and close together, white or yellowish, when cut or bruised turning a purplish hue; stem stuffed or hollow, viscid, smooth, equal or slightly tapering towards the cap, white; milk white, changing to lilac, acrid. Height 2 to 4 inches. Cap 2 to 4 inches broad. In woods.

Lactarius *turpis* Fries. Cap viscid, compact, *zoneless*, greenish umber, margin clothed with yellowish down; gills thin, paler than the cap; stem hollow or stuffed, stoutish, short, viscid, olive color, slightly attenuated towards the base; milk *white, acrid.* Fir woods.

Lactarius *plumbeus* Fries. Cap fleshy, firm, dry, somewhat hairy, varying in color, usually some shade of brown; gills yellowish, thin, and close together; stem solid, equal, lighter in color than the cap; flesh white; milk *white* and *acrid.*

Lactarius *vellereus* Fries. *Fleecy Lactarius.* Cap compact, convex or umbilicate, zoneless, *minutely downy;* margin reflexed, gills white, *distant*, arcuate; stem short, solid, pubescent; milk *white, acrid*, somewhat scanty. In woods. Whole plant white.

Lactarius *piperatus* Scop. *Peppery Lactarius.* Cap fleshy, compact, convex and slightly umbilicate, at last deeply depressed, becoming funnel-formed, smooth and even; gills decurrent, very narrow, thin, even and close together, dichotonous, white; flesh white; milk *white, extremely acrid*, copious; stem very short, stout, solid. Whole plant white.

Lactarius *blennius* Fries. Cap depressed, slimy or glutinous, greenish-gray; margin incurved and somewhat downy. Gills narrow, white or whitish; stem stuffed or hollow, viscid, and of same color as the cap or paler; milk white and very acrid.

M. C. Cooke divides the genus Lactarius into 4 "Tribes": (1) Piperites, in which the stem is central, gills *unchangeable*, naked, neither discolored nor *pruinose*, milk at first *white* and *commonly acrid;* (2) Dapetes, in which the stem is central, gills naked, *milk from the first deeply colored;* (3) Russulares, in which the stem is central, gills pallid, *then discolored*, becoming darker, changing when turned to the light, at length *pruinose*, with milk at *first white* and *mild* and *sometimes becoming acrid;* (4) Pleuropos, in which the stem is concentric or lateral.

To the first of these subdivisions, *Piperites*, belong all of the Lactars enumerated above. The Russians eat the Piperites only after the water of the first boiling has been taken off.

Lactarius *rufus* Scop., a very acrid species of large size, having reddish ochraceous gills and zoneless cap of reddish yellow with white milk, belongs to the subdivision Russulares. Common in fir woods. Dangerous.

Lactarius *volemus* Fries, a tawny yellow-capped mushroom with white gills changing to a yellowish hue, and copious *sweet* white milk, belongs also to the latter subdivision. Edible.

Russula (Fragiles) *emetica* Fries. Cap fleshy, at first convex, then expanded or depressed, smooth, polished, red, margin sulcate: gills free, equal and broad, white; stem solid but somewhat spongy in the center, smooth, short, stoutish, white or stained reddish; flesh white, sometimes slightly tinted red, under the thin red cuticle. The cap of this mushroom varies from a deep rich crimson to a pale pinkish red, being very subject to atmospheric changes. Specimens are often found with the cap washed almost white after heavy rains, or with but a slight red spot in the center. The gills and spores are pure white, and the flesh peppery to the taste. If tasted when raw the juice should not be swallowed.

The variety *Clusii* has a blood-red cap, pallid yellowish gills, adnexed, becoming adnate. Spores white. In woods. Acrid. The variety *fallax* is fragile, with dingy reddish pileus and adnexed, distant, whitish gills.

Besides the above-mentioned, there are other acrid Russulas and Lactars which are regarded with suspicion, though not as yet satisfactorily tested.

Poisonous Boleti.

Several of the Boleti have the reputation of being poisonous or deleterious, among them Boletus *luridus*, Boletus *Satanas*, and Boletus *felleus*. Kobert's analysis of B. *luridus* shows the presence of the poisonous alkaloid muscarin in this mushroom, while the bitterness of B. *felleus* should make one chary of eating it in quantity, if at all. Schmiedeberg and Koppe describe experiments made with Boletus Satanas, in which the symptoms experienced closely resemble those of muscarin poisoning.

A correspondent living in Georgia, who is quite familiar with the species, writes that he has frequently eaten the yellow form of the *muscaria*, when cooked, without serious inconvenience. Another correspondent writes that he has eaten the species Boletus luridus and Boletus Satanas, as well as several other mushrooms of poisonous repute, with perfect impunity.

Without calling in question the testimony of persons who state that they have with impunity eaten mushrooms generally found to be poisonous, it must be said that even if, through local conditions of soil or climate, the poisonous constituents of such mushrooms sometimes exist in comparatively minute proportions, or are *neutralized* by an unusual proportion of *mushroom atropin* in the plant, or eliminated by some process used in its preparation for the table, or, finally, if constitutional

idiosyncrasies should enable some persons safely to eat what is poisonous to others, the rule that such are to be avoided should never be disregarded by the ordinary collector, nor should it be departed from even by experts, except upon the clearest evidence that in the given case the departure is safe. It is certainly the part of discretion, when in doubt, to take no risks.

Recent Instances of Mushroom Poisoning.

About a year ago a physician in Vineland, New Jersey, furnished the following in regard to his personal experience of the effects of mushroom poisoning: "My wife, daughter, and self selected, according to an article in the Encyclopedia Britannica, what we thought were a nice lot of mushrooms, cooked them in milk, and ate them for dinner with relish. In a few hours we were vomiting, laughing, and staggering about the house. We could not control ourselves from the elbows to the finger tips, nor our legs from the knee to the ends of our toes. In other words, we were drunk on mushrooms. The mushrooms grew within the shade of Norway spruce and other ornamental trees on the lawn in front of our house. They were pure white inside and out: smooth shiny tops that easily peeled off. The caps were about two or three inches in diameter, and had a stem of the same length. On the day before, my wife and a friend ate some of these mushrooms raw and experienced no bad effects. The next day at noon we ate them cooked in milk with a little butter, and they were very good. About two o'clock our food did not seem to digest well, and soon my daughter, sixteen years of age, vomited all her dinner. Then my wife began to feel the effects, and took hot water freely, sweet oil, currant wine, and at last an overdose of tartar-emetic. Of course, she was the sickest of all. I was cool and happy and amused at the situation, and drunk from my head down. I did not vomit, and my mushrooms remained with me for at least 48 hours. I took nothing but hot water and sweet oil. A friend of my daughter's of her own age partook of the mess and had not a single bad symptom."

A physician from West Grove, Pennsylvania, writes: "I determined to risk a test of the Amanita muscaria. Accordingly, two good-sized specimens were steamed in butter. I ate one, and another member of my family ate the other, feeling that the consequences could not be serious from so small an amount. About an hour after eating, a sensation of nausea and faintness was experienced in both cases, followed by nervous tingling, some cold perspiration and accelerated and weakened action of the heart. Considerable prostration ensued within two hours. Knowing that sulphate of atropin has proved the most successful remedy for the active principle of the Fly agaric, Amanita muscaria, a small dose, one-sixtieth of a grain, was taken by each. Considerable relief was experienced within 30 minutes, and all unpleasant symptoms had disappeared within 6 hours, without repeating the medicine."

Another case, wherein the antagonism of atropin for muscarin was demonstrated, was brought to our notice during the month of September of the past year. An entire party of people were badly poisoned by eating mushrooms, and, although a doctor was called in very late, most of them were saved by the use of sulphate of atropin.

It would seem from the foregoing cases that the intensity and action of the mushroom poison must depend in some degree on the constitution of the individual, as well as on the quality and quantity of the mushrooms eaten. The first treatment should be to get rid of the poison immediately and by every possible means, so as to prevent or at least arrest the progress of inflammation of the alimentary canal, and at the same time to prevent the absorption of the poison. In a majority of cases the recovery of the victim depends solely upon the promptness with which vomiting is excited. Vertigo, convulsions, spasms, and other grave nervous symptoms, which ordinarily follow the cessation of the most important functions, yield, ordinarily, to the action of an emetic without the necessity of ulterior remedies, if taken in time, while the substance is yet in the stomach; when it has entered the lower bowels purgation is necessary. Sweet oil should always be taken in combination with castor oil, or such other purgatives as are used. Enemas of cassia, senna, and sulphate of magnesia have also been used with good effect.

The fatal poisoning of Count Achilles de Vecchj, in November, 1897, by eating the Amanita muscaria, is so fresh in the public recollection, and the details in regard to it, were so widely published through the newspaper press, that it is unnecessary to take up space in recapitulating the circumstances.

The death of Chung Yu Ting, in 1894, was occasioned by eating mushrooms which he had collected in a patch of woods near Washington, D. D., and which I identified at the time as Amanita phalloides, sometimes called the "Death Cup." He had eaten very freely of this mushroom and died after great suffering, although ten hours had elapsed before the toxic effects began to show themselves.

Since it has been shown that vinegar and the solution of common salt have the power to dissolve the alkaloids of the poisonous mushrooms, it follows that the liquor thus formed must be extremely injurious. It should, therefore, be obvious that vinegar and salt should not be introduced into the stomach after poisonous mushrooms have been eaten. The result would only be to hasten death. Ether and volatile alkali are also attended with danger. A physician should in all cases be promptly called, and, if muscarin poisoning is suspected, hypodermic injections of the sulphate of atropin, the only chemical antidote known to be efficacious, should be administered, the dose being from $\frac{1}{100}$ up to $\frac{1}{35}$ of a grain. Small doses of atropin can also be taken internally, to accelerate heart action. To relieve the pains and irritation in the abdomen sweet oil and mucilaginous drinks should be given.

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CORRECTION OF PLATES.

Part 1.

Plate B. Fig. 4 should read Fig. 5, Fig. 5 should read Fig. 4.

Part 2.

Plate D. Fig. 3, the exposed inner surface of the cap, should be *smooth*, not *ridged*, as the straight lines in the engraving might suggest.

Plate V. For Lactarious read Lactarius.

Part 3.

Plate VIII. The red on the upper surface of the cap is too bright in tint. It should be a dull brick-red.

Plate IX. Fig. 6. The spores should be a deeper tint or brownish purple.

The spores as delineated on the plates represent a magnification of from 400 to 500 diameters.

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